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UNITED STATES AIR FORCE
INSTALLATION RESTORATION PROGRAM

FINAL

Third Five-Year Review Report for Area D/
American Lake Garden Tract

Joint Base Lewis McChord – McChord Field, Washington



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March 2010

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Lead Agency Approval

Third Five-Year Review

Joint Base Lewis McChord – McChord Field—Area D/ALGT NPL Site

This signature sheet documents the Joint Base Lewis McChord-McChord Field approval of the third Five-Year Review for the Area D/ALGT NPL Site at McChord Field.



Kevin J. Kibb, Colonel, USAF
62d Airlift Wing Commander

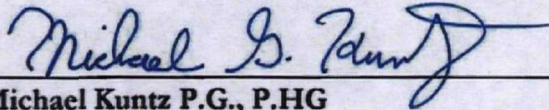
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Support Agency Acceptance

Third Five-Year Review

Joint Base Lewis McChord – McChord Field—Area D/ALGT NPL Site

This signature sheet documents the Washington State Department of Ecology acceptance of the third Five-Year Review for the Area D/ALGT NPL Site at McChord Field.



Michael Kuntz P.G., P.HG

Toxics Cleanup Program

Washington State Department of Ecology

3-23-10

Date

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
Air Force	U.S. Air Force
ALGT	American Lake Garden Tract
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
CY	calendar year
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
ft	feet
ft/day	foot per day
GAC	granular activated carbon
gpm	gallons per minute
IC	institutional control
IRP	Installation Restoration Program
JBLM	Joint Base Lewis-McChord
µg/L	micrograms per liter
MCL	Maximum Contaminant Level
Mgal	million gallons
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operations and Maintenance
RAO	Remedial Action Objective
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
TCE	trichloroethene
URSG	URS Greiner Woodward Clyde
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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EXECUTIVE SUMMARY

The purpose of this Five-Year Review is to evaluate the implementation and performance of the remedial actions that were selected in the Record of Decision (ROD) for the Area D/American Lake Garden Tract (ALGT) National Priorities List site at the former McChord Air Force Base, Washington, now part of Joint Base Lewis McChord. McChord (JBLM). The US Army will assume full operational capability of JBLM-McChord Field in October of 2010. The remedy selected by the ROD is groundwater extraction and treatment to eliminate or reduce the risks posed by the site to levels that are protective of human health and the environment. This is the third Five-Year Review for the Area D/ALGT site. The triggering action for this review was the signing of the second Five-Year Review report on April 7, 2005.

The Five-Year Review Summary Form on the following pages presents the issues that were identified during the review, provides associated recommendations and follow-up actions, and includes a protectiveness statement.

The assessment of this Five-Year Review found that the pump-and-treat system has operated as designed since the second Five-Year Review and continues to accomplish static plume containment, but without measurable reduction in contaminant concentrations within the current plume boundary. The historical known extent of the plume lies entirely within base property; therefore, remediation goals for groundwater have been attained offbase in the ALGT. Although contaminant concentrations in the current plume boundary are not diminishing, institutional controls are in-place to eliminate current risk pathways onbase.

While the remedy implemented at Area D/ALGT is protective offbase, and exposure pathways have been controlled effectively until remediation goals are achieved onbase, the absence of reduction of contaminant concentrations within the current plume boundary suggests that the pump-and-treat system operation may not achieve the remediation goals throughout the plume within a reasonable timeframe (estimated at 50 years in the ROD).

Further identification and evaluation of alternatives to reduce source term and to enhance dissolved plume remediation is planned for calendar year (CY) 2010.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: AMERICAN LAKE GARDEN/MCCHORD AFB		
EPA ID: WAD980833065		
Region: 10	State: WA	City/County: Tacoma, Pierce County
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify)		
Remediation status: Operating		
Multiple OUs?* No		Construction completion date: 9/29/1994
Has site been put into reuse? Golf course remains in use; shallow aquifer use restricted.		
REVIEW STATUS		
Lead agency: U.S. Air Force		
Author name: William Myers		
Author title: Restoration Program Manager,		Author affiliation: JBLM – Environmental Division
Review period: 3/2005 to 3/2010		
Date(s) of site inspection: On-going inspections by operators		
Type of review: <div style="text-align: right;"><input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion</div>		
Review number: 3 (third)		
Triggering action: <div style="display: flex; justify-content: space-between;"><div><input type="checkbox"/> Actual RA Onsite Construction at OU # _____ <input type="checkbox"/> Construction Completion <input type="checkbox"/> Other (specify)</div><div><input type="checkbox"/> Actual RA Start at OU # _____ <input checked="" type="checkbox"/> Previous Five-Year Review Report</div></div>		
Triggering action date: 3/2005		
Due date: 4/7/2010		

* ["OU" refers to operable unit.]

Five-Year Review Summary Form, cont'd.**Issues:**

Continued reduction of contaminant concentrations to meet remediation goals within the entire current plume boundary is not being accomplished by the pump-and-treat system.

Continued reduction of the plume boundary since the second Five-Year Review has not occurred, potentially reducing the long-term protectiveness of the remedy.

All necessary Institutional Controls/Land Use Controls (ICs/LUCs) are not currently documented in an enforceable agreement.

Recommendations and Follow-up Actions:

Identify and evaluate alternatives to reduce source term and enhance dissolved plume remediation, including verifying that the source area conceptual site model is correct.

Issue ROD modification for any remedy updates or document ICs/LUCs in an enforceable agreement upon change from McChord AFB to Joint Base Lewis McChord.

Protectiveness Statement(s):

The remedial action at Area D/ALGT has been completed, the remedy is protective in the short term of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. In the offbase area of ALGT, groundwater meets remediation goals (drinking water criteria). The Air Force has provided public water supply connections to residents and restricted the shallow aquifer to non-potable uses to control current threats at the site. Onbase in Area D, in order for the remedy to be protective in the long-term, the remediation goal of restoring the aquifer to its beneficial use must be met and ICs/LUCs must be fully implemented in an enforceable agreement.

Long-term Protectiveness:

Long-term protectiveness of the remedial action will be verified by groundwater monitoring to confirm that the TCE plume exceeding remediation goals remains onbase and that the contaminant concentrations within the plume boundary reduce over time. ICs/LUCs will be documented in an enforceable agreement to prevent the completion of potential exposure pathways onbase. Further identification and evaluation of alternatives to reduce source term and to enhance dissolved plume remediation is planned for CY 2010.

Other Comments:

None.

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I. INTRODUCTION

The U.S. Air Force (Air Force) prepared this Five-Year Review report for the Area D/American Lake Garden Tract (ALGT) site at former McChord Air Force Base (AFB), now part of Joint Base Lewis McChord (JBLM), Washington, pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). Area D/ALGT is the first of two operable units placed on the National Priorities List (NPL) at McChord AFB in October 1984 and currently is on the Final NPL (U.S. Environmental Protection Agency [EPA] ID# WAD980833065). A second, previously listed site at McChord AFB—the Washrack/Treatment Area—was delisted from the NPL on September 26, 1996, and was addressed in two separate Five-Year Review reports. Groundwater contamination at the Area D/ALGT site is being addressed through federal actions. The Air Force is currently the lead agency for cleanup of Area D/ALGT, and the Washington State Department of Ecology (Ecology) is the lead regulatory agency, with the EPA as the secondary regulatory agency. The 62nd Airlift Wing Commander and the 62nd Mission Support Group Commander are signatories to the Federal Facilities Agreement (FFA) signed on August 23, 1989.

In 2005 Congress mandated that McChord AFB and Fort Lewis merge as a joint base, with Lewis to be the receiving installation. Initial Operating Capability was implemented on 1 February 2010 which included the name change for both Fort Lewis and McChord AFB to Joint Base Lewis McChord (JBLM). The former McChord AFB is now referenced as Joint Base Lewis McChord – McChord Field or JBLM McChord Field. Full Operational Capability will occur on 1 October 2010 at which time the property accountability will transfer from McChord to JBLM. Air Force retains responsibility for the property until the transfer, at which time the Army will assume responsibility.

Joint Base Lewis McChord conducted this Five-Year Review of the remedial actions implemented at Area D/ALGT based on data collected through December 2009. The triggering action for the review was the completion date of the second Five-Year Review, identified as April 7, 2005, in EPA's WasteLAN database. Tetra Tech EC, Inc. supported Joint Base Lewis McChord in this review through their contract with the Air Force Center for Engineering and the Environment (AFCEE). The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment, and includes identification of any issues with the remedy and recommendations to address them.

This is the third Five-Year Review conducted for the Area D/ALGT site. The first Five-Year Review, completed in March 2000, concluded that the remedy was protective of human health and the environment (U.S. Air Force 2000). Both Ecology and EPA concurred with this assessment. The review was initiated because contaminant concentrations in groundwater at the site exceed levels that would allow unlimited use and unrestricted exposure. The purpose of this review is to determine whether the remedy at the site is protective of human health and the environment and whether the remedy remains the most appropriate action for the site.

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II. SITE CHRONOLOGY

Table 1 provides a summary of events for the Area D/ALGT site.

Table 1. Chronology of Site Events for Area D/ALGT

Event	Date
Disposal activities at the site	mid-1940s to early 1970s
Department of Defense Installation Restoration Program (IRP) initiated at McChord AFB	1981
IRP Phase I—Records search	1982
IRP Phase II—Site investigation	1983
Discovery/Preliminary Assessment	1983
Proposal to EPA NPL	1983
Final listing on EPA NPL	1984
Interim remedial activities—bottled water provided to private residences	1984–1986
Residences located within 5-micrograms per liter (µg/L) contour of the trichloroethene (TCE) plume connected to the public water system	1986
Remedial Investigation/Feasibility Study (RI/FS) negotiations completed	1988
Federal Facilities Agreement between Air Force, EPA, and Ecology finalized	1989
Human Health Risk Assessment finalized	1990
Ecological Risk Assessment finalized	1991
RI/FS finalized	1991
Proposed Plan identifying EPA's preferred remedy presented to public; start of public comment period	1991
Record of Decision (ROD) selecting the remedy signed	1991
Remedial Design completed	1992
Began on-site construction of groundwater containment and treatment system	1993
Completed connection of all residents in ALGT to the public water system	1993
Containment system startup	1994
Operations and Maintenance (O&M) Plan approved by EPA	1994
Completed on-site construction of groundwater containment and treatment system	1994
Extraction well DX-1 shut down due to low concentrations in aquifer	1999
First Five-Year Review completed	2000
Extraction well DX-2 shut down due to low concentrations in aquifer	2003
Extraction well DX-2 pump replaced and returned to service due to resource protection well slightly above remediation goal	2004
Second Five-Year Review completed	2005
Sampling for 1,4-dioxane completed	2005
Identification and evaluation of alternatives to reduce source term and enhance dissolved plume remediation.	2010
Third Five-Year Review completed	2010

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III. BACKGROUND

Physical Characteristics

Area D/ALGT is located approximately 7 miles south of downtown Tacoma in central Pierce County, Washington. Geographical features that roughly bound the site include Interstate 5 to the northwest, Porter Hills and McChord AFB ammunition storage area to the north, Burlington Northern Railroad and "A" Street to the east, Westcott Hills and Fort Lewis Logistic Center to the south, and ALGT to the southwest (Figure 1). Area D lies in the southwestern portion of McChord Field, where several disposal areas were operated at various times from the mid-1940s to the early 1970s. The Whispering Firs Golf Course (and driving range) now overlies several of the former Area D disposal areas. McChord Field also contains a large residential area in the southwestern portion of Area D. Immediately southwest of Area D lies the offbase residential housing of the ALGT.

Glacial sedimentary deposits that underlie Area D/ALGT consist of permeable sand and gravel outwash materials separated by till layers and interspersed non-glacial units. The Vashon Drift is the geologic unit exposed at the surface and consists of gravel, recessional outwash, till, and advance outwash units, as well as lacustrine silt. The uppermost hydrogeologic unit within the Vashon Drift hosts the shallow, unconfined aquifer within outwash sand and gravel. The unconfined aquifer extends from approximately 20 feet (ft) below ground surface (bgs) to a depth between 80 and 160 ft bgs. Two elongated hills created by glacial action (Westcott and Porter Hills) direct the flow of groundwater within the unconfined aquifer at Area D/ALGT; groundwater flows generally in an arc from the east to southwest or west-northwest at an approximate mean rate of 0.4 ft per day (ft/day), with seasonal variations. There is a hydraulic barrier between the upper unconfined and the deeper aquifers.

Land and Resource Use

Area D was originally described in the Recommendations on page 112 of the Installation Program Records Search For McChord Air Force Base dated 1982. A base golf course and driving range now overlie former landfills that were part of the Area D disposal areas. Southwest of Area D/ALGT is a large onbase residential area that was expanded in 1998 and now houses approximately 3,500 residents. There are currently 828 housing units, of which 118 are vacant. When redevelopment of the housing area is completed in approximately 7 years there will be 712 housing units.

ALGT is an offbase residential tract abutting the southwestern boundary of McChord Field that lies between Joint Base Lewis McChord property and Interstate 5. This tract consists of 1,183 housing units with approximately 3,400 residents.

Onbase and offbase water supplies are not threatened because groundwater is withdrawn from deeper sources located away from Area D/ALGT. McChord Field withdraws drinking water from deeper aquifers and has no extraction wells in the shallow, unconfined aquifer. The offbase ALGT residential area had drinking water wells installed in the shallow aquifer at the time of discovery. Subsequently, the residential area was connected to the Lakewood Water District Water Supply System that derives drinking water from a source away from the site, as described below under Initial Response.

In 1998 the former McChord AFB expanded its southwestern boundary into a portion of Area D/ALGT. This adjustment added 23.15 acres to base property, as indicated by the positions of the former and current base boundaries (Figure 1). As a result of the property acquisition, the furthest documented downgradient extents of the TCE groundwater plume at the EPA Maximum Contaminant Level (MCL) of 5 µg/L (or parts per billion) or greater and cis-1,2-dichloroethene (cis-1,2-DCE) groundwater plume at the EPA MCL of 70 µg/L or greater were contained entirely within the former McChord AFB boundary. Figures 2 and 3 show the current base boundary and the historical and current plume extents for TCE and cis-1,2-DCE.

History of Contamination

Table 1 provides a summary of completion dates for enforcement and cleanup actions for Area D/ALGT. The Department of Defense IRP was initiated at McChord AFB in March 1981. The Phase I Records Search (CH2M HILL 1982) identified seven past and current potential waste disposal sites. The follow-up Phase II investigation reported low-level organic contamination at several of these sites within Area D and recommended further studies to confirm contaminant characteristics and distribution. In 1983, a resident living near the base boundary contacted EPA about family health problems believed to have been caused by drinking contaminated water. Concurrent with the Phase II IRP investigation, EPA and the Tacoma-Pierce County Health Department sampled private ALGT drinking water wells and found elevated metals concentrations and volatile organic compounds (VOCs), including TCE and cis-1,2-DCE. In 1984, EPA concluded that Area D of McChord AFB in the vicinity of former Landfill 5 was the likely source of groundwater contamination in Area D/ALGT. Seven former sites within Area D subsequently were included in the NPL listing of the Area D/ALGT site: Landfill 4, Landfill 5, Landfill 6, Landfill 7, Ordnance Disposal Area 26, Radioactive Disposal Well 35, and Old Burn Trench 39. Listing of the site initiated the CERCLA RI/FS process.

The amount of TCE disposed of at the site is unknown (Ebasco 1991a). The RI also documented that source area mass of TCE and cis-1,2-DCE is not likely within the vadose zone (i.e., Landfill 5) but rather at a depth of about 60 feet below ground surface, or roughly 40 feet below the water table (Ebasco 1991a).

Groundwater characterization identified a low-concentration contaminant plume (TCE < 85 µg/L) in the shallow aquifer that originated in Area D. The contaminant plume as defined by detectable concentrations of VOCs has extended up to approximately 3,500 ft downgradient of an old landfill (Site LF-05) into or near the northeast corner of the former offbase ALGT boundary. In addition to the consistent presence of TCE and cis-1,2-DCE in the plume, occasional trace detections of vinyl chloride and 1,1-DCE have occurred. Hydrogeologic complexities in the shallow aquifer have created a bifurcation in downgradient groundwater flow directions, largely influenced by the presence of glacial drumlins of Westcott and Porter Hills, that appears to have formed southwestern-trending and western-trending segments of the contaminant plume (see plume shapes on Figures 2 and 3). No occupied buildings overlie the historical extent of groundwater contaminants that exceed the remediation goals.

The RI documented that concentrations of TCE and cis-1,2-DCE in groundwater diminish with distance of transport, principally due to dispersion and dilution (Ebasco 1991a). An evaluation of biodegradation by URS Greiner Woodward Clyde (URSG) and Foster Wheeler Environmental

Corporation (1998a) and current review of monitoring results show that some degradation by dehalogenation (removal of chlorine from the compound) occurs, albeit at slow rates. Some evidence of the slow degradation includes an increase with transport distance in the ratio of daughter product to parent product for cis-1,2-DCE and TCE and the occasional detection mid-plume of trace amounts of vinyl chloride (daughter product to cis-1,2-DCE). The quantity of TCE in the dissolved groundwater plume was estimated at 1-2 gallons during the RI, based on plume dimensions and median contaminant concentrations (Ebasco 1991a). The current amount of TCE removed from the aquifer (approximately 7 gallons) indicates the potential for a secondary source of contamination beneath Landfill 5, as posed during the RI (Ebasco 1991a).

Monitoring conducted between February 1989 (initiation of RI sampling) and November 1993 (last sampling event prior to system startup in February 1994) does not provide evidence that the TCE groundwater plume was migrating. Pre-remedial action concentrations for wells nearest LF-05 (DA-7b and DA-21b), wells located mid-gradient within the plume (DA-29 and DB-6), and wells at the fringe of the plume (DA-28 and EPA-W-5) are presented on Table 2. As shown, concentrations in these representative wells remained fairly consistent over the 5-year period prior to system startup, with no apparent trend toward increasing concentrations up to the point of implementation of the pump-and-treat system. In addition, mean concentrations for the wells since the second Five-Year Review do not show a marked decrease.

Table 2. Pre-Remedy TCE Concentrations in Representative Site Wells

Location	Well ID	RI							Post-RI/Pre-RA			Prior 5 Years
		2/89	5/89	8/89	11/89	3/90	6/90	9/90	1/92	7/93	11/93	Mean
Nearest LF-05	DA-7b	--	82	76	62	88	--	--	96	58	74	72
	DA-21b	--	--	--	57	62	80	46.5	62	56	45	40
Mid-gradient	DA-29	--	--	--	--	--	--	--	--	17	14	12
	DB-6	--	19	18	7	4.5	--	--	22	20	13	6.6
Plume fringe	DA-28	--	--	--	--	--	--	--	--	1	0.92	0.39
	EPA-W-5	0.23	0.28	1	0.59	--	--	--	0.1	0.6	0.26	0.46

Initial Response

A Memorandum of Agreement was signed in September 1985 between the Air Force, EPA, Ecology, Washington Department of Social and Health Service, and the Tacoma-Pierce County Health Department that required the installation of a permanent alternative water supply for the ALGT. The Air Force subsequently provided bottled water to residents in the ALGT affected by well contamination. By mid-1986 the residents within the 5- μ g/L contour of the TCE plume were connected to the public water system, replacing the need for bottled water. As a follow-on action in 1992, the Air Force offered free hookups to all property owners in the ALGT, and those owners that accepted the offer were connected by June 1993.

Basis for Taking Action

The RI (Ebasco 1991a) characterized the nature and extent of contamination in groundwater, soil, surface water, and sediments. The Human Health Risk Assessment and the Ecological Risk Assessment (summarized in Ebasco 1991a) evaluated potential effects of the contamination on

human health and the environment. The FS (Ebasco 1991b) evaluated alternatives for remediation of the contamination.

Groundwater monitoring results reported in the RI showed that concentrations of TCE exceeding the Maximum Contaminant Level (MCL) of 5 µg/L were present in a groundwater plume roughly 3,000 ft in length (see historical plume contour on Figure 2). A similar plume extent was identified for cis-1,2-DCE, a daughter product of TCE (Figure 3). Vinyl chloride and 1,1-DCE have also been identified as contaminants of concern in the ROD; however only occasional detections at trace levels have been reported. The baseline Human Health Risk Assessment (Ebasco 1991a) determined that unacceptable risks exist for groundwater ingestion and groundwater inhalation by onbase residents and offbase residents and groundwater ingestion by long-term workers based on maximum detected contaminant concentrations. The unacceptable risks for groundwater ingestion have been mitigated by prohibiting usage of the contaminated water as a drinking water source. Recent modeling for evaluation of inhalation risks associated with a higher concentration TCE plume at McChord AFB yielded vapor concentrations below Model Toxics Control Act (MTCA) regulatory limits. Landfill 5 in Area D was identified as the source of the groundwater contamination, although source concentrations in soil were not identified. As no unacceptable human or ecological risk was identified for soil, surface water, or sediment (Ebasco 1991a), the ROD determined a need only for a remedial action for groundwater (EPA et al. 1991). The other six sites that comprise the Area D/ALGT NPL site were determined to pose no unacceptable risk to human health or the environment; however, LUCs were required over those landfills.

IV. REMEDIAL ACTIONS

Remedy Selection

The selected remedial action alternative stated in the ROD (EPA et al. 1991) included connection of ALGT residents to a public water system and the extraction and treatment of groundwater in a long-term effort to remediate the drinking water aquifer. As stipulated in the ROD, only the contaminant plume associated with Landfill 5 required remedial action for Area D/ALGT. Furthermore, the ROD also stated that no remedial action was necessary for soil, surface water, or sediment. The remedial action selected by the ROD specifies restoration of groundwater to its beneficial use as a drinking water source.

The ROD opted for a pump-and-treat remedial action with installation of three groundwater extraction systems (designed and installed as one well per system) “to create a hydrologic barrier to prevent further offbase migration of contaminants above the MCLs and to treat the most contaminated groundwater beneath the Area D site,” with the expectation that the action would “remediate the contaminated plume off-site and on-site” (EPA et al. 1991). The engineered remedial action consists of three extraction wells—one well installed along the former western boundary of McChord AFB (well DX-1), one well installed in the northern portion of the contaminant plume (well DX-2), and one well installed near Site LF-05 (well DX-3); a treatment plant to treat extracted groundwater; and two recharge trenches to reinfiltrate treated water downgradient of the TCE plume (Figure 4), as presented in the final Remedial Design (USACE 1992). Other components of the remedy include: 1) long-term monitoring to confirm system performance and plume stability or reduction, 2) connection of ALGT households to the public water supply, and 3) establishment of institutional controls (ICs) that restrict the use of contaminated groundwater within Area D/ALGT to non-potable applications. The ROD requires the Air Force to “implement administrative and institutional controls. The treatment plant removes dissolved VOCs by passing water through two granular activated carbon (GAC) vessels. Monitoring is conducted for groundwater wells, treatment plant influent, and treatment plant effluent. The system started operation on February 15, 1994.

The ROD specifies one Remedial Action Objective (RAO) for Area D/ALGT to “restore groundwater to its beneficial use, a drinking water source.” Remediation goals listed in Table 16 of the ROD for individual compounds in groundwater are summarized in Table 3. The standards for TCE and cis-1,2-DCE have remained the same since 1991. EPA downgraded the carcinogenicity of 1,1-DCE in 2002, which results in a higher MTCA Method B value such that the appropriate basis is now the MCL of 7 µg/L. In addition, the MTCA Method B value for vinyl chloride was updated in 2001 to 0.03 µg/L.

Table 3. Groundwater Remediation Goals in ROD for Area D/ALGT

Compound of Concern	Groundwater Remediation Goal in $\mu\text{g/L}$ ¹	Basis of Remediation Goal ²
TCE	5	MCL
cis-1,2-DCE	70	MCL
1,1-DCE	0.07	MTCA Method B ³
Vinyl chloride	0.04	MTCA Method B ³

¹ Treatment plant effluent must meet the groundwater remediation goals, as well as meet the pH range of 6.5 to 8.5.

² Determination of remediation goals is presented in the ROD (EPA et al. 1991).

³ Ecology MTCA Method B cleanup level for groundwater in 1991.

Remedy Implementation

The Air Force provided connections to the Lakewood Water District Water Supply System for households within the plume extent by 1986 and completed additional connections by June 1993 for ALGT households that accepted the Air Force's offer of free connections. The Remedial Design of the groundwater pump-and-treat system was begun on November 18, 1991, and completed on November 13, 1992 (USACE 1992). The Air Force began construction of the system on April 14, 1993, and the extraction wells and treatment system started operation on February 15, 1994. All construction was determined to be complete on September 29, 1994.

The pump-and-treat system has been operating since 1994 resulting in containment of the TCE plume to beneath the Whispering Firs Golf Course. Reduction in concentrations within the groundwater plume has allowed two of the three extraction wells (DX-1 and DX-2) to be placed on a standby "non-pumping status," although DX-2 was later returned to service. Plume contaminant concentrations were sufficiently low in the vicinity of the furthest downgradient pumping well, DX-1, for the well to be turned off on December 14, 1999. Similarly, low contaminant concentrations for the central portion of the plume allowed the central pumping well, DX-2, to be turned off on February 18, 2003. Well DX-3—the pumping well closest to Site LF-05—remained as the sole operating extraction well until DX-2 was restarted on July 13, 2004, at the request of Ecology. To compensate in part for cessation of other wells, the extraction rate for DX-3 was increased first in February 2003 from 75 to 80 gallons per minute (gpm), and then again in October 2003 to 100 gpm to increase the capture zone width.

Results of operations of the pump and treat system from February 1994 through December 2009, the Area D/ALGT pump-and-treat system has achieved the following (Tetra Tech EC, Inc. 2010, in preparation):

- Approximately 1 billion gallons of groundwater withdrawn, treated by GAC, and recharged.
- Approximately 38 kilograms TCE removed (equivalent to 83 pounds or 7 gallons), or about 6 percent of the total amount of available TCE according to current estimates. The estimated total mass of source area TCE (420 kg) is documented in the CY 2008 annual report (Tetra Tech EC, Inc. 2009a), and is based on the ratio between the rate of TCE removal (kg/day) and the cumulative TCE removed (kg). This proportionality implies that the concentration of dissolved-phase TCE in groundwater is proportional to the

concentration in soils and ultimately the total quantity of TCE that remains in the absorbed phase.

- Approximately 78 kilograms cis-1,2-DCE removed (equivalent to 172 pounds or 15 gallons), or about 30 percent of the total amount of available cis-1,2-DCE according to current estimates. The estimated total mass of source area DCE (225 kg) is documented in the CY 2008 annual report (Tetra Tech EC, Inc. 2009a).
- Approximately \$6.2 million spent on remedial action (see O&M discussion below).

In the 16 years of pump-and-treat system operation and approximately 20 years since completion of the RI, changes have occurred in plume configuration and extent relative to the former McChord AFB boundary. The following conditions describe the current Area D/ALGT groundwater contaminant plume (as discussed in the Data Review of Section VI):

- Reduction has occurred in the length of the TCE plume as delineated by the 5- μ g/L contour. The length of the southwestern segment has decreased from roughly 3,000 ft in 1991 to roughly 1,400 ft in 2009.
- TCE and cis-1,2-DCE have maintained essentially constant concentrations over time in the resource protection wells within the current plume boundary and/or closest to Site LF-05 (wells DA-7b, DA-9b, DA-21b, DA-29, DB-6).
- With adjustment of the former McChord AFB boundary to the southwest by land acquisition, the historical greatest extent of the TCE and cis-1,2-DCE plumes above MCLs (5- μ g/L contour for TCE, 70- μ g/L contour for cis-1,2-DCE) lie entirely within the base boundary (Figures 2 and 3)
- Groundwater extraction has reduced the current areal extent of the TCE plume; however, data collected between May 1989 and November 1993 (prior to system startup in February 1994) provide evidence that the groundwater plume had likely reached a steady-state equilibrium, and would not migrate beyond the former McChord AFB boundary in the absence of active containment.
- No current exposure pathways exist for Area D/ALGT groundwater contaminants.

These plume characteristics are consistent with findings of the RI, which concluded that the Area D/ALGT plume was stable (i.e., not expanding downgradient) as a result of a static source and natural processes that decreased concentration with transport distance. While operation of the pump-and-treat system apparently has reduced the extent of groundwater containing contaminants exceeding MCLs, the remedial action has not been necessary for preventing offbase migration of contaminants above MCLs. Furthermore, operation of the pump-and-treat system does not appear to be reducing contaminant concentrations within the current plume boundary since the late 1990s. Vinyl chloride is only occasionally reported at levels close to the laboratory detection limit.

The ICs for Area D/ALGT are specified in the General Plan (U.S. Air Force 2005). Although these ICs exist in the General Plan they were not accepted as part of an EPA approved enforceable

document, and there is no designated body to periodically review the condition of sites with ICs. The existing ICs minimize the potential for completing exposure pathways and ensure human health and the environment are not threatened. ICs specific to the Area D/ALGT include:

1. Listing and generating plan view maps showing the Area D/ALGT as an IRP site.
2. Designated land use at the Area D/ALGT for the source area and groundwater plume is for open space/recreation (i.e., golf course).
3. Restriction of land development within the Area D/ALGT that stipulates no new development within the plume boundary until remediation is complete, whereby all proposed projects are subject to review and approval by Environmental Management Flight staff.
4. Restriction of groundwater usage from the shallow water table aquifer at the Area D/ALGT for non-potable purposes only. All base potable water is obtained from deeper aquifers that are not within the site boundary.
5. Offbase ICs administered by the Pierce County Department of Health includes the Pierce County Washington Comprehensive Plan at 19A.90.070(A)(1)(4) prohibiting construction of new individual domestic wells in Urban Growth Areas when properties are within 600 ft of a public water system main. Potable water from the Lakewood Water District is available throughout the ALGT.

The Air Force also has administrative procedures that require approval for projects requiring construction, subsurface soil disturbance, or changes in land use. Air Force Instructions and procedures require coordination with and prior approval be obtained from Environmental Management Flight staff if a proposed project is located on or near an IRP site.

The Air Force details Area D/ALGT site conditions and sampling results in both quarterly technical information and annual reports. These reports are submitted to Ecology for review and comment. Finalized reports are collected, digitized and placed on removable media (CDs) as part of the administrative record. This digital administrative record is currently available to the public at the Tacoma Public Library Northwest Reading Room.

The current base contact for ICs for the Area D/ALGT is William Myers, Restoration Chief, Environmental Management Flight, 62 CES/CEV, 253-982-6202 (or his designee).

System Operations/Operations and Maintenance

The Area D/ALGT pump-and-treat system has run consistently since startup in February 1994. Operations follow the final Operation and Maintenance Plan (USACE 1994a) and final Remedial Action Work Plan (USACE 1994b), with updated procedures provided in yearly Quality Project Plans for the Groundwater Treatment Plant Monitoring and Optimization Program (latest version, Tetra Tech EC, Inc. 2009b). Table 4 identifies groundwater extraction and treatment rates and cumulative extraction volumes for the 16 years of operation.

Table 4. Summary of Groundwater Extraction/Treatment Flow Rates

Well ID	Design Flow Rate (gpm)	Flow Rate Average (gpm)																Cumulative Flow through December 31, 2009 (Milliongallons)
		Year of Operation																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
DX-1	25	19	26	25	24	23	23	0	0	0	0	0	0	0	0	0	0	67
DX-2	40	32	36	36	37	28	26	26	34	29	1	21	39	39	30	38	36	229
DX-3	75	60	75	66	50	67	66	69	73	75	82	87	77	91	79	69	82	577
Total	140	105	136	126	114	111	121	105	118	108	108	115	114	138	130	135	144	1,006

Combined extraction rates for the system have varied between 105 and 144 gpm compared to the maximum design rate of 140 gpm. The information in Table 4 reflects placement of wells DX-1 and DX-2 on standby in December 1999 and from February 2003 through July 2004, respectively. A cumulative total of approximately 1 billion gallons have been extracted for treatment over a 16-year period of near-continuous operation (Figures 5 and 6). Individual extraction well rates are shown on Figure 7. GAC treatment has removed contaminants effectively, as shown by concentration differences for TCE and cis-1,2-DCE treatment plant influent and effluent on Figures 5 and 6 (Figure 5 depicts method detection limits for TCE, as no detections have been reported in effluent), and nine carbon change-outs have been required thus far in the 16 years of operation.

The following describes operational changes since the second Five-Year Review:

- Well DX-1 has remained on standby since December 14, 1999, because the groundwater quality of the extraction well and nearby monitoring wells met the remediation goals identified in Table 3 in the vicinity of the well. Concentrations of TCE in well DX-1 since the first Five-Year Review have remained below remediation goals. Placement of well DX-1 on standby was accompanied by additional groundwater monitoring to confirm groundwater quality.
- Well DX-2 has been in operation, pumping at, or near, the design rate of 40 gpm. Initial placement of well DX-2 on standby in CY 2003 was accompanied by additional groundwater monitoring to confirm groundwater quality. Subsequently, well DX-2 was returned to service on July 13, 2004 (after replacement of the turbine pump with a submersible pump) in response to Ecology concerns regarding groundwater concentrations of TCE in nearby resource protection well DO-2, which has consistently been between 5 and 6.5 µg/L since system startup.
- Well DX-3 has been in operation, pumping at, or near, the design rate of 75 gpm. The extraction rate for well DX-3 was increased from 75 gpm to approximately 80 gpm in February 2003 to increase the capture zone. The rate was increased again in October 2003 to approximately 100 gpm. During CY 2004, well DX-3 was set to pump at a maximum of 100 gpm, as long as the water table elevation was sustainable above the critical shutoff level. The pump in DX-3 was replaced and the well rehabilitated in response to decreasing efficiency. The geometric mean concentration of TCE for well DX-3 since the second Five-Year Review is approximately 11.5 µg/L. There is no apparent trend of increasing or decreasing concentrations in well DX-3 during the previous 5 years.
- Sampling for 1,4-dioxane was completed in March 2005 at the request of EPA. There were no detections of the compound above the laboratory reporting limits of 5 µg/L.

Costs for the Area D/ALGT remedy—including design, construction, and operation—total approximately \$6.2 million to date. Current operations, maintenance, and monitoring costs total roughly \$250,000 per year, and the occasional change-out of GAC every 18 months or so costs about \$20,000 each time. Estimated system costs to date are shown in Table 5.

Table 5. Area D/ALGT System Design, Construction, and Operations/O&M Costs

Activity	Dates		Approximate Cost
	From	To	
Remedial Design	1991	1992	\$1,000,000
Remedial Action Construction	1993	1994	\$1,000,000
Annual Operations/O&M Costs at \$250,000 per year	1994	2009	\$4,000,000
GAC Change-outs—9 at \$20,000 each	1994	2009	\$180,000
Approximate Total Costs (through December 2009)	1991	2009	\$6,180,000

Considering the mass removed to date, as reported above under Remedy Implementation, the system design, construction, and operation equates to \$74,000 per pound TCE or \$880,000 per gallon TCE, as well as \$36,000 per pound cis-1,2-DCE or \$410,000 per gallon cis-1,2-DCE, if considered separately. Conversely, approximately 1 billion gallons of contaminated groundwater have been extracted, treated, and returned to the aquifer at the rough cost of 0.6 cents per gallon. Containment also has reduced the areal extent of the plume that exceeds the remediation goals, thereby further increasing available supplies of potable water.

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V. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

The second Five-Year Review (Tetra Tech FW, Inc. 2005a) determined that the selected remedy was protective of human health and the environment. EPA requested that the Air Force collect samples for 1,4-dioxane and evaluate alternatives and remedy enhancements through an optimization study or focused feasibility study. Follow-up actions are listed in Table 6.

In its letter of concurrence with the Five-Year Review (Tetra Tech FW, Inc. 2005a, attachment), EPA identified that the Area D/ALGT ROD does not contain all the requirements for ICs at operating federal facilities, as established in EPA's *Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities* (1999). The General Plan (U.S. Air Force 2005) was revised in April 2005 and specifies land development processes for base projects. This plan identifies Area D/ALGT and applies the permitting process to prevent inappropriate development of the site.

Table 6. Actions Taken Since the Second Five-Year Review

Recommendations from Previous Review	Party Responsible	Action Taken and Outcome	Date of Action
Collect groundwater samples for analysis of 1,4-dioxane	JBLM	Samples collected and concentrations of 1,4-dioxane below laboratory reporting limit of 5 µg/L.	March 2005
Issue Proposed Plan for any remedy updates, including any clarifications needed on the institutional controls as well as cleanup levels due to updated toxicity information.	JBLM	A Proposed Plan was not completed as no remedy updates were initiated. McChord Field's updated General Plan shows Area D/ALGT as the greatest areal extent of the contaminant plume and stipulates no development for any IRP site until remediation is completed.	April 2005
Conduct Optimization Study	JBLM	Identification and evaluation of alternatives to reduce source term and enhance dissolved plume remediation	To be completed during CY 2010

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VI. FIVE-YEAR REVIEW PROCESS

Administrative Components

The Area D/ALGT Five-Year Review team was led by William Myers, Restoration Chief, Environmental Management Flight, McChord AFB 62 CES/CEV. A scoping meeting to initiate the third Five-Year Review was conducted by Mr. Myers on September 24, 2009, that included representatives of McChord AFB, EPA, Ecology, Tetra Tech EC, Inc. and Fort Lewis.

Community Notification and Involvement

The public was notified by newsletter in September 2008 when approximately 11,000 copies were mailed. The newsletter stated that the Air Force is re-evaluating the selected remedy of the ROD to determine whether the pump-and-treat system is efficiently and effectively reducing the associated risks posed by contaminants at this site. The public will be notified via newspaper advertisement at the completion of the final Five-Year Review report, with copies made available at the public library.

Document Review

This Five-Year Review consists of a review of relevant documents including, but not limited to, Annual Reports that contain O&M records and monitoring data (see Data Review below). A list of reference documents is contained in Attachment 2. Applicable groundwater cleanup standards, as listed in the 1991 ROD, were reviewed. Current values for MCLs and MTCA Method B levels listed as remediation goals on Table 3 were checked for changes since issuance of the ROD.

Data Review

The status of Area D/ALGT operations and results of groundwater monitoring are reported each year in the Annual Report (Hart Crowser 1995, 1996; URSG and Foster Wheeler Environmental Corporation 1997, 1998b, 1999, 2000; FPM Group, Ltd. and Foster Wheeler Environmental Corporation 2001; Foster Wheeler Environmental Corporation 2002, 2003; Tetra Tech FW, Inc. 2004, 2005; and Tetra Tech EC, Inc. 2006, 2007, 2008, 2009a). Monitoring has demonstrated that groundwater contamination consists of VOCs comprised primarily of TCE and cis-1,2-DCE, as well as occasional trace amounts of 1,1-DCE and vinyl chloride. Therefore, groundwater currently is monitored for VOCs.

Adherence with ICs/LUCs are checked on a weekly basis during treatment system inspections. In addition, all subsurface construction must be reviewed and approved by the Environmental Flight.

Groundwater monitoring results since the second Five-Year Review (2005 through 2009) show that TCE and DCE values within the current plume boundary (wells DA-7b, DA-9b, DA-21b, DA-29, DB-6) may have reached asymptotic (steady state) concentrations while slowly decreasing values of TCE and DCE are still observed in downgradient resource protection wells. Figures 2 and 3 illustrate the decreased extent of concentrations exceeding remediation goals (5 µg/L for TCE and 70 µg/L for cis-1,2-DCE). The length of the TCE plume with concentrations greater than 5 µg/L has decreased from roughly 3,000 ft at the time of the RI (1991) to roughly 1,400 ft at present (Figure 2, averaged for March and September 2009). Trends over time for wells along the plume centerline are shown for TCE and cis-1,2-DCE on Figures 8 and 9, in which a source location is

chosen arbitrarily at 100 ft east of well DA-7b. As seen in Figures 8 and 9, the most significant reductions in concentration since the start of pump-and-treat operations in 1994 have occurred in wells more distant from the source. Of the wells portrayed in Figure 8, those that exceeded the remediation goal for TCE prior to containment (DA-7b, DA21b, and DA-29) still remain higher than the goal. Figure 9 shows that only well DA-7b remains above the remediation goal for cis-1,2-DCE while well DA-21b has dropped below the goal.

Extraction wells DX-1, DX-2, and DX-3 have decreasing contaminant concentration trends as shown on Figures 10 and 11, which are typical for pump-and-treat systems. TCE concentrations in DX-1 dropped below the remediation goal after 1 year of operation, while TCE concentrations in DX-2 have remained less than the goal throughout the period of operation. TCE concentrations in DX-3 were reduced about 50 percent during the first 3 years of operation, but remain above the TCE remediation goal at levels between 10 and 15 $\mu\text{g/L}$. Only DX-3 began operations above the cis-1,2-DCE remediation goal, but concentrations were quickly reduced to levels well below the goal (Figure 11). Consistent discharge concentrations below the remediation goals led to shutting off well DX-1 in December 1999 and well DX-2 in February 2003. Well DO-2 adjacent to extraction well DX-2 produced monitoring results in 2003 for TCE slightly above the remediation goal of 5 $\mu\text{g/L}$. This result for TCE above the remediation goal led to the restart of well DX-2 on July 13, 2004, in accordance with prior agreement with Ecology. The extraction rate for DX-3 was increased to approximately 80 gpm in February 2003 and then to approximately 100 gpm in October 2003 to increase the capture zone upgradient of DX-2. Increased extraction at DX-3 was shown by discharge monitoring to have increased mass removal for TCE in a linear relationship with the pumping rate increase; however, insufficient time was provided prior to the restart of DX-2 to determine whether the increased capture at DX-3 would reduce concentrations in downgradient wells.

The TCE and cis-1,2-DCE plumes were identified as stable in the RI, and the consistent concentrations observed at well DA-7b near the source and consistent to decreasing concentrations in downgradient wells (Figures 8 and 9) support that assessment. Data indicate that operation of the pump-and-treat system has reduced the area of the plume that exceeds the remediation goals, but has not achieved reduction of contaminant concentrations to meet remediation goals everywhere within the current plume boundary.

Site Inspection

Activities and review associated with preparation of the CY 2009 Annual Report served as the site inspection. This review indicates the following conditions:

- Extraction well DX-1 remains on standby.
- Extraction well DX-2 continues to pump at, or near, the design flow rate of 40 gpm.
- Extraction well DX-3 continues to pump at, or near, the design flow rate of 75 gpm.
- The GAC treatment system is operating as designed, and nine carbon change-outs in 16 years is a reasonable rate for the technology.
- Recharge trenches operate generally without incident.

- Resource protection wells remain in usable condition.
- ICs/LUCs are verified on a weekly basis.
- A Base Civil Engineering Work Request Form (AF 103) is approved prior to any construction at the site.

Interviews

Facts concerning the operation of the treatment plant have been obtained from Tetra Tech EC, Inc. and David T. Johnson Engineers, contractors responsible for O&M of the Area D/ALGT treatment plant system since 1995.

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VII. TECHNICAL ASSESSMENT

The technical assessment follows EPA guidance (EPA 2001) and answers the following three questions:

- **Question A:** Is the remedy functioning as intended by the decision documents?
- **Question B:** Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?
- **Question C:** Has any other information come to light that could call into question the protectiveness of the remedy?

Question A: Is the remedy functioning as intended by the decision documents?

Yes. The remedy is intended to eliminate or reduce the risks posed by the site to levels that are protective of human health and the environment. Containment of the plume is being achieved, although it appears that operation of the pump-and-treat system is not needed to contain offbase migration of contaminants exceeding the MCLs. Operation of the pump-and-treat system has resulted in a reduced areal extent of the TCE plume exceeding 5 µg/L; however, no additional reductions in areal extent have been observed since the late 1990s. In addition, contaminant concentrations within the current plume boundary may have reached asymptotic conditions since the second Five-Year Review.

In general, the remedial action is operating and functioning as designed. The system has operated consistently and with few periods of shutdown. Extraction wells have achieved successful containment (capture), and have experienced relatively minor biofouling (Tetra Tech EC, Inc. 2010, in preparation). GAC treatment has met effluent requirements with a reasonable rate of carbon change-outs (nine in 16 years). Reinfiltration of treated water in the recharge trenches has operated successfully. Furthermore, low concentrations of contaminants in the shallow aquifer adjacent to extraction well DX-1 have allowed cessation of pumping that has been replaced by increased monitoring. DX-2 was also shut down in February 2003, as a result of low VOC concentrations detected at nearby wells, but was restarted in July 2004 at the request of Ecology. TCE concentrations at one monitoring well near DX-2 exceeded 5 µg/L (up to 6.5 µg/L) and Ecology expressed the concern that drinking water standards must be met or controlled throughout the plume in order to maintain regulatory consistency with the ROD. The ROD states that "The goal of this remedial action is to restore groundwater to its beneficial use, which is, at this site, a potential drinking water source by attaining drinking water standards throughout the groundwater aquifer" and that the plume will be monitored "to ensure that groundwater remediation goals are achieved and maintained throughout the contaminant plume."

The long record of monitoring demonstrates that no contaminants in the groundwater plume exceeding the MCLs have migrated beyond the base boundary. The historical and current extents of TCE and cis-1,2-DCE concentrations exceeding the MCLs are confined to McChord AFB property, even without the enhanced containment provided by the pump-and-treat system. Data presented in

Table 2 provide evidence that the plume dimensions and contaminant concentrations had likely reached a steady-state equilibrium prior to system startup. Furthermore, extraction of groundwater and removal of contaminants is expensive on a mass-removal basis due to low plume concentrations (approximately \$74,000 per pound or \$880,000 per gallon TCE), although treated groundwater has returned approximately one billion gallons of potable water to the aquifer at less than 0.6 cents per gallon and containment has reduced the plume area that exceeds remediation goals.

The monitoring record also demonstrates that operation of the pump-and-treat system has not reduced source concentrations to date. The record at well DA-7b during 16 years of consistent system operation shows constant concentrations of TCE and cis-1,2-DCE (Figures 8 and 9). Persistence of TCE and cis-1,2-DCE concentrations indicates that the pump-and-treat system has not significantly affected the source of the low-concentration plume. This finding is consistent with results at many sites that indicate applying only pump-and-treat remediation technology may fail to achieve groundwater restoration within a reasonable timeframe (EPA 1996). Implementation of either a supplemental or alternative remedy may be appropriate for achieving faster source reduction.

The Area D/ALGT site is within a designated wetland and the range safety fan for the ammunition storage area. Development is prohibited. The site is inspected on a weekly basis and all proposed construction activities must follow permit procedures that are reviewed by the Environmental Flight. Consequently, ICs (control of land use and control of withdrawal of shallow groundwater) continue to effectively prevent human exposure to groundwater contamination by eliminating potential exposure pathways. Inclusion of specific LUCs in the ROD by a ROD modification to implement the use restrictions in the original ROD, as recommended in the second five-year review, have not been accomplished.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

Yes. Groundwater standards identified as remediation goals (Table 3) were reviewed for changes since issuance of the ROD in 1991. MCLs for the two principal contaminants of the Area D groundwater plume—TCE and cis-1,2-DCE—have remained unchanged at 5 µg/L and 70 µg/L, respectively. EPA downgraded the carcinogenicity for 1,1-DCE on its Integrated Risk Information System in 2002, thereby increasing the calculated MTCA Method B cleanup level for 1,1-DCE above the MCL of 7 µg/L. Therefore, the MCL now is the appropriate basis for the remediation goal (Table 7). Furthermore, the MTCA cleanup level for vinyl chloride has changed from 0.04 to 0.03 µg/L (Table 7); however, this concentration is roughly an order of magnitude less than laboratory detection limits. This review recommends changing remediation goals identified in Table 3 to values shown in Table 7. At the higher value of 7 µg/L, the groundwater monitoring record shows that the revised remediation goal for 1,1-DCE would be satisfied throughout Area D/ALGT (no detections reported above the laboratory practical quantitation limits of between 0.2 and 1.3 µg/L).

McChord AFB acquired 23.15 acres in 1998 that adjusted the base boundary in the vicinity of Area D/ALGT, as shown on Figure 1. With this change, the historical extent of groundwater contamination above MCLs lies entirely within McChord AFB property. Therefore, groundwater contamination at unacceptable risks no longer reaches offbase residential areas, and groundwater

quality offbase meets standards for a drinking water source. McChord AFB previously offered residents in the ALGT connections to the public water supply, and those accepting the offer were connected by June 1993. Under these circumstances, no reasonable human health exposure pathway exists for offbase residents. Furthermore, no human health exposure pathway exists for onbase residents or long-term onbase workers, who receive water from the McChord AFB water system that draws from deeper aquifers protected from the Area D/ALGT plume. These changes make the remedy more protective than previously considered.

The one RAO for the Area D/ALGT specified in the ROD is to “restore groundwater to its beneficial use, a drinking water source.” Progress is being made toward meeting the RAO of returning the aquifer to meet drinking water standards. In the onbase area, the extent of the groundwater plume within Area D has been reduced, as shown in Figures 2 and 3. In the offbase area, contaminants exceeding drinking water standards have not migrated beyond the base boundary and the RAO has been met. The ROD estimates that the RAO can be met in approximately 50 years; however, current data for the remedy offer no evidence that the source is decreasing at a significant rate.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No. A newly recognized association of the compound 1,4-dioxane, which may have been mixed with TCE at 1 to 5 percent as a solvent stabilizer, raised the possibility of its presence in groundwater at the Area D/ALGT site during the second 5-year review. Analysis for 1,4-dioxane was performed in March 2005. No detections of the compound were reported above the laboratory method reporting limits of 5 µg/L at that time; however, the MTCA Method B groundwater cleanup level has been changed from 7.95 µg/L to 4 µg/L since sampling and analysis was completed. Despite this change in the MTCA Method B cleanup level to 4 µg/L (which is below the laboratory method reporting limit), the difference between 5 µg/L and 4 µg/L does not call into question the protection of the remedy because the cancer risk at 5 µg/L is still well within the EPA acceptable risk range.

Technical Assessment Summary

The remedy implemented at Area D/ALGT is currently considered protective of human health and the environment. Operation of the pump-and-treat system initially reduced the overall areal extent of the groundwater plume onbase exceeding remediation goals by approximately 50 percent; however, no noticeable further reduction of the plume has been observed since the late 1990s. The absence of reduction of contaminant concentrations within the current plume boundaries also suggests that the current remedy may not achieve the remediation goals throughout the plume within a reasonable timeframe (e.g., 50 years, as stated in the ROD). Current estimates of TCE mass removal indicate that approximately 6 percent of the total amount of TCE available (documented in the CY 2008 annual report, Section 4.5) has been removed in 16 years of operation, which also points to a longer remedial timeframe than originally anticipated. New information, understanding, and changed site conditions subsequent to issuance of the ROD in 1991, as enumerated below, may warrant a new evaluation of the selected remedy:

- Several remedial technologies developed or improved since the ROD have gained frequent application to chlorinated VOC sites, including in situ chemical oxidation, enhanced reductive dechlorination, and monitored natural attenuation.
- Connections to municipal water supplies and ICs that restrict shallow aquifer use to non-potable applications have eliminated potential exposure pathways.
- The greatest known areal extent of the groundwater plume above regulatory levels is now fully contained within base property following changes to the McChord AFB property boundary.
- Absence of verifiable source reduction after 16 years of pump-and-treat operation suggests that the selected remedy may require more time or optimization to attain remediation goals than previously hoped.

An increase in protectiveness is realized from existing ICs that have provided connections to municipal water supply, restricted shallow aquifer use to non-potable applications, and stipulated no new development within the site onbase until remediation is complete, thereby eliminating potential exposure pathways. RAOs and remediation goals for Area D/ALGT remain applicable. There is no other information that calls into question the protectiveness of the remedy.

Table 7. Changes in Chemical-Specific Standards

Contaminant	Media	Remediation Goal	Standard	
			Previous	New
1,1-DCE	Groundwater	7 µg/L	0.07 µg/L	7 µg/L
			7 µg/L	0.07 µg/L
Vinyl Chloride	Groundwater	0.03 µg/L	0.04 µg/L	0.03 µg/L
			0.03 µg/L	0.04 µg/L

VIII. ISSUES

Issues related to the effectiveness and long-term effectiveness of the site remedy are listed in Table 8.

Table 8. Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Continued reduction of contaminant concentrations to meet remediation goals within the entire current plume boundary is not being accomplished by the pump-and-treat system.	N	Y
Continued reduction of the plume boundary since the second Five-Year Review has not occurred, potentially reducing the long-term protectiveness of the remedy.	N	Y
All necessary ICs/LUCs are not currently documented in an enforceable agreement.	N	Y

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IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Recommendations and follow-up actions are listed in Table 9.

Table 9. Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Continued reduction of contaminant concentrations to meet remediation goals within the entire current plume boundary is not being accomplished by the pump-and-treat system.	Identify and evaluate alternatives to reduce source term and enhance dissolved plume remediation, including verifying that the source area conceptual site model is correct.	Joint Base Lewis McChord	Ecology/EPA	December 31, 2010	N	Y
Continued reduction of the plume boundary since the second Five-Year Review has not occurred, potentially reducing the long-term protectiveness of the remedy.	Identify and evaluate alternatives to reduce source term and enhance dissolved plume remediation, including verifying that the source area conceptual site model is correct.	Joint Base Lewis McChord	Ecology/EPA	December 31, 2010	N	Y
All necessary ICs/LUCs are not currently documented in an enforceable agreement.	Issue ROD modification for any remedy updates or document ICs/LUCs in an enforceable agreement upon change from McChord AFB to Joint Base Lewis McChord	Joint Base Lewis McChord	Ecology/EPA	June 30, 2011	N	Y

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X. PROTECTIVENESS STATEMENT(S)

The remedial action at Area D/ALGT has been completed, the remedy is protective in the short term of human health and the environment, and exposure pathways that could result in unacceptable risks are being controlled. In the offbase area of ALGT, groundwater meets remediation goals (drinking water criteria). Onbase in Area D, in order for the remedy to be protective in the long-term, the remediation goal of restoring the aquifer to its beneficial use by meeting RAOs throughout the plume must be met and ICs/LUCs must be fully implemented in an enforceable document. In the interim, the Air Force has provided offbase public water supply connections to residents and restricted the shallow aquifer to non-potable uses to control current threats at the site.

In order for the remedy to be protective in the long term, the RAO of restoring the aquifer to its beneficial use must be attainable in a reasonable timeframe. If the remedy cannot further reduce plume dimensions and contaminant concentrations, then alternative remedies should be explored via an optimization study.

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XI. NEXT REVIEW

The next Five-Year Review for Area D/ALGT is required 5 years from the date of this review.

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ATTACHMENTS

Attachment 1

Figures

PROJECT AREA

Groundwater
Treatment
Plant

Interstate 5

McChord AFB

Barnes
Boulevard

Porter Hills

AMMUNITION
STORAGE

Area D

Whispering
Firs
Golf Course

Wescott
Hills

American Lake
Garden Tract

Fort Lewis
Logistic Center

Burlington Northern
Railroad

LEGEND



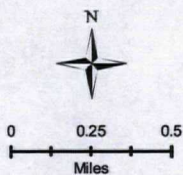
Project Area



Base Boundary - Current



Base Boundary - Former



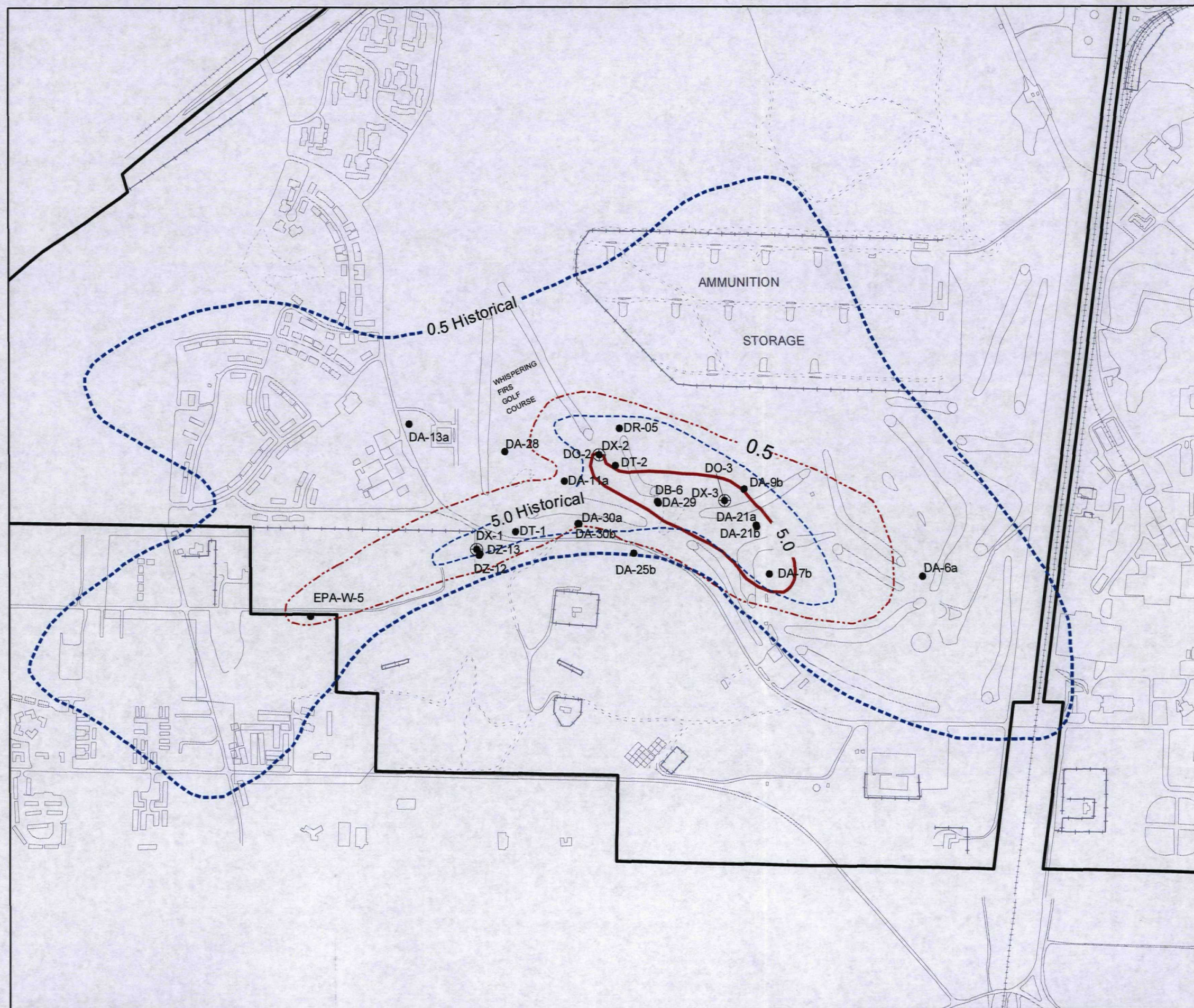
RA-O McChord Area D/ALGT
Third 5-Year Review Report

Figure 1
Vicinity Map

Date: 10/2009



TETRA TECH EC, INC.



LEGEND

- ⊕ Extraction Wells
- Resource Protection Wells
- TCE Concentration = 0.5 µg/L (March and September 2009)
- TCE Concentration = 5 µg/L (March and September 2009)
- Extent of Historical Plume = 0.5 µg/L
- Extent of Historical Plume = 5 µg/L
- Base Boundary
- Railroad
- Fence

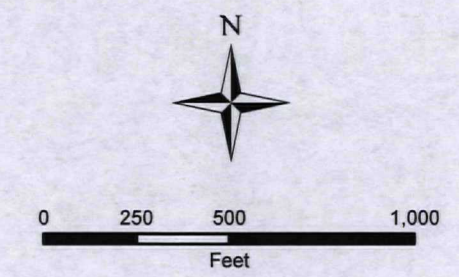
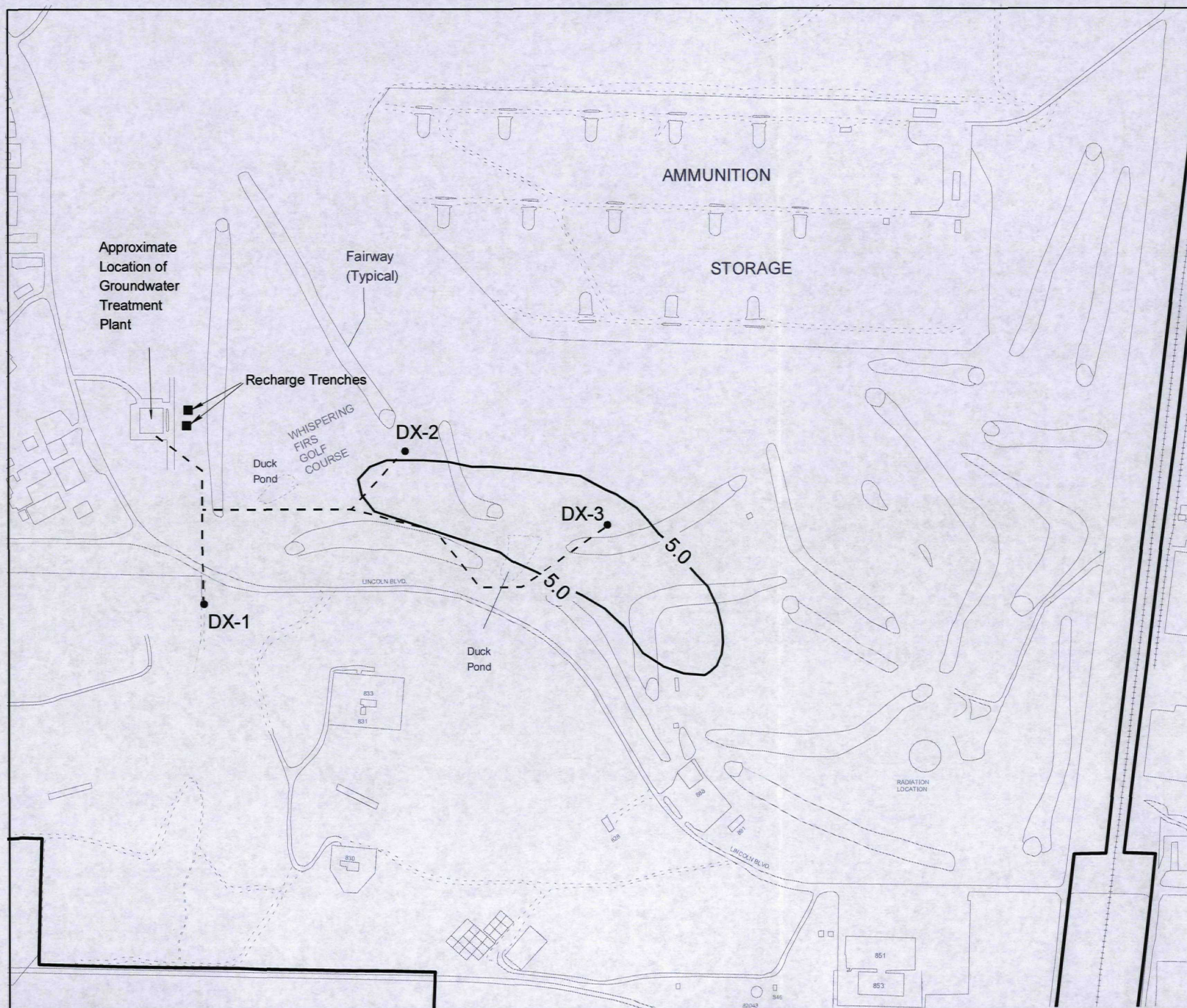
Note: This is a color drawing. Do not reproduce in black and white.

RA-O McChord Area D/ALGT
Third 5-Year Review Report

Figure 2
TCE Groundwater Plume
Evolution Map

Date: 10/2009





LEGEND

- Recharge Trenches
- Extraction Wells
- - - Extraction Well Pipeline Location
- 5.0 TCE Concentration = 5 µg/L (March and September 2009)
- Base Boundary
- - - Unpaved Road Limits
- ... Drainage Limits
- - - Fence
- - - Railroad

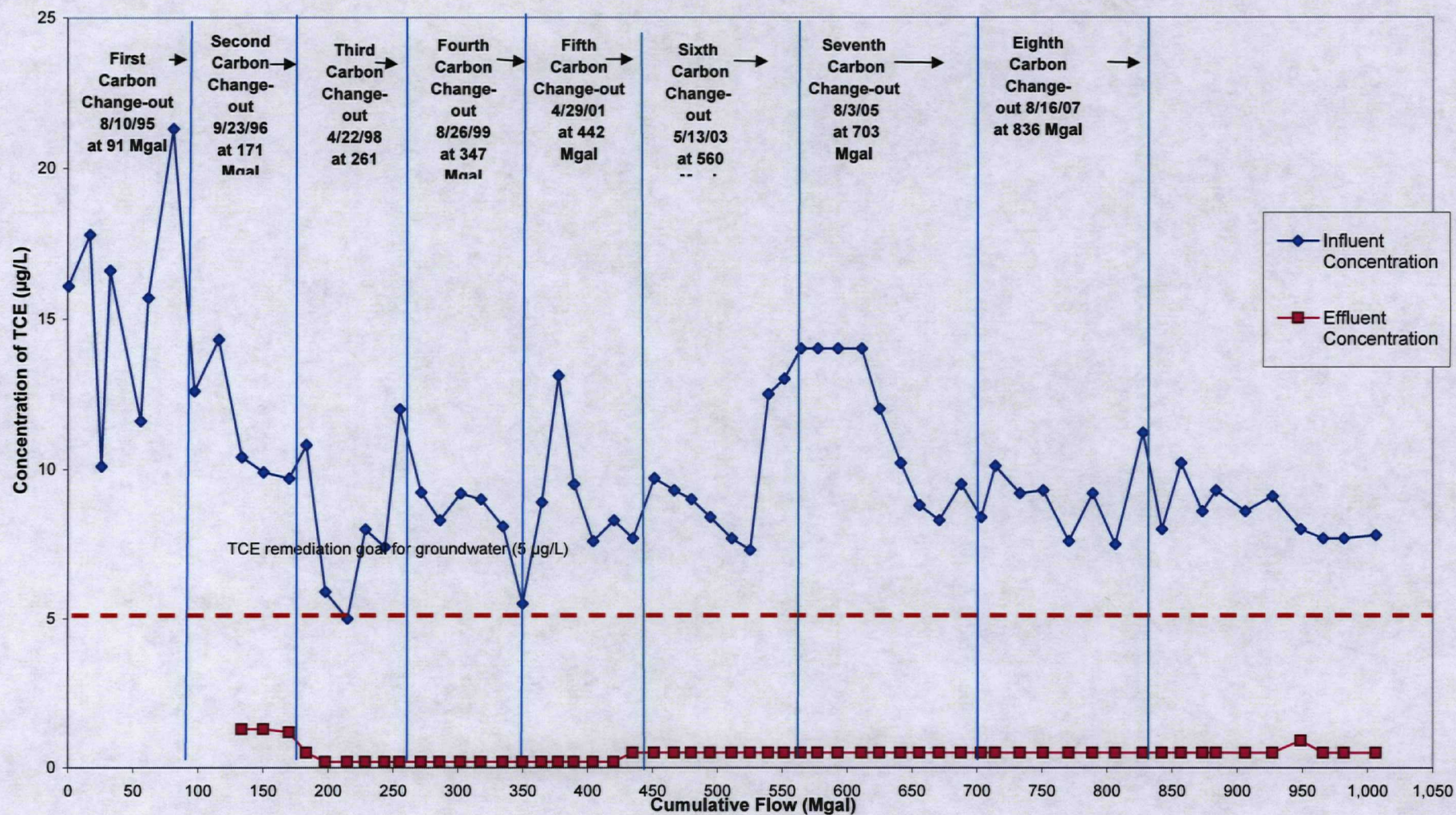
RA-O McChord Area D/ALGT
Third 5-Year Review Report

Figure 4
Site and Groundwater Extraction
Well Location Map

Date: 10/2009



Figure 5
Treatment Plant TCE Concentration vs. Cumulative Flow
McChord AFB Area D



Note: All TCE effluent results were not detected and are shown at their method reporting limit on this graph.
TCE influent concentrations are estimated based on a flow-weighted calculation.

Figure 6
Treatment Plant cis-1,2-DCE Concentration vs. Cumulative Flow
McChord AFB Area D

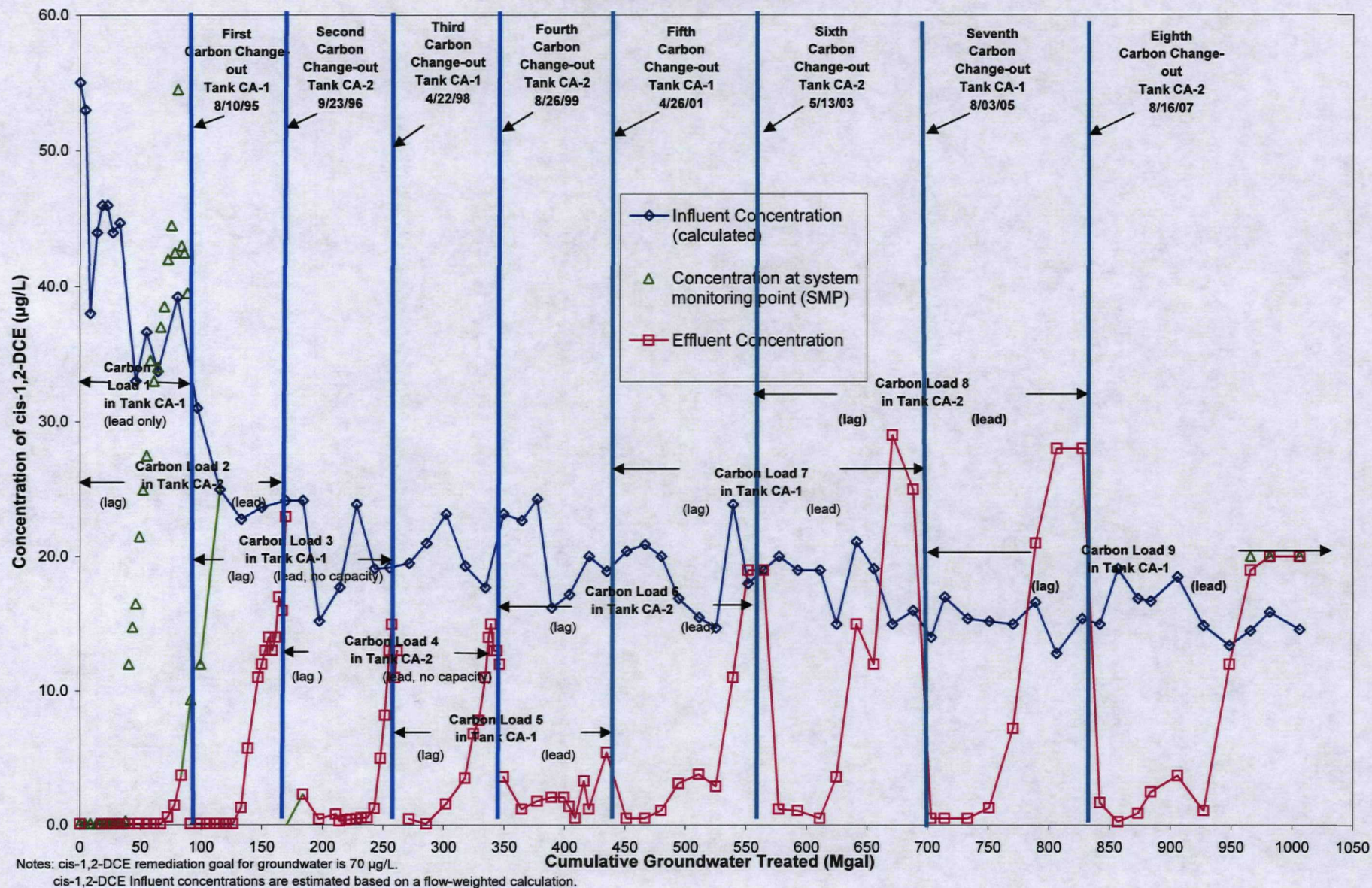
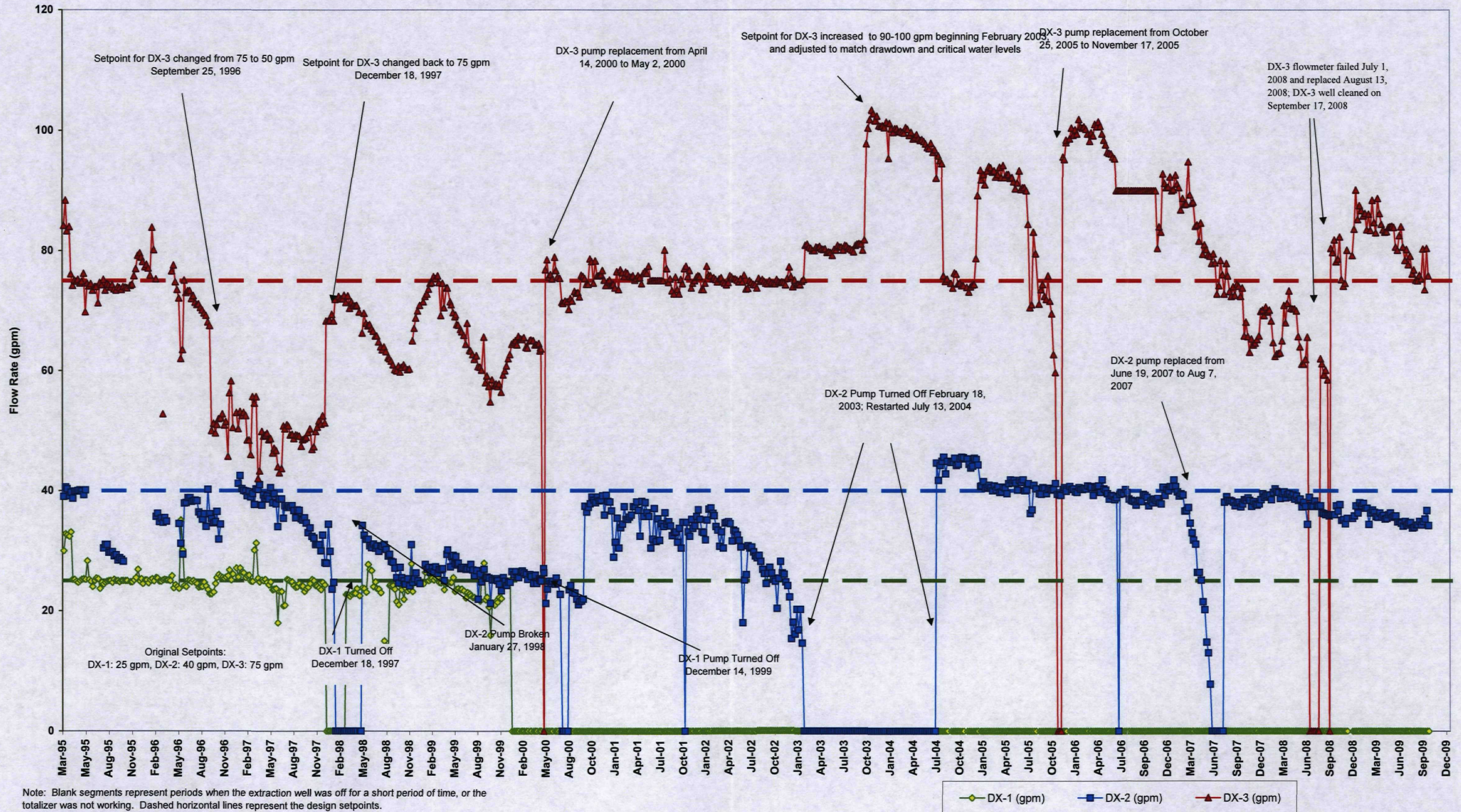


Figure 7
Extraction Well Flow Rates Over Time
McChord AFB Area D



Note: Blank segments represent periods when the extraction well was off for a short period of time, or the totalizer was not working. Dashed horizontal lines represent the design setpoints.

Figure 8
TCE Concentrations Over Time in Resource Protection Wells Along Plume Centerline

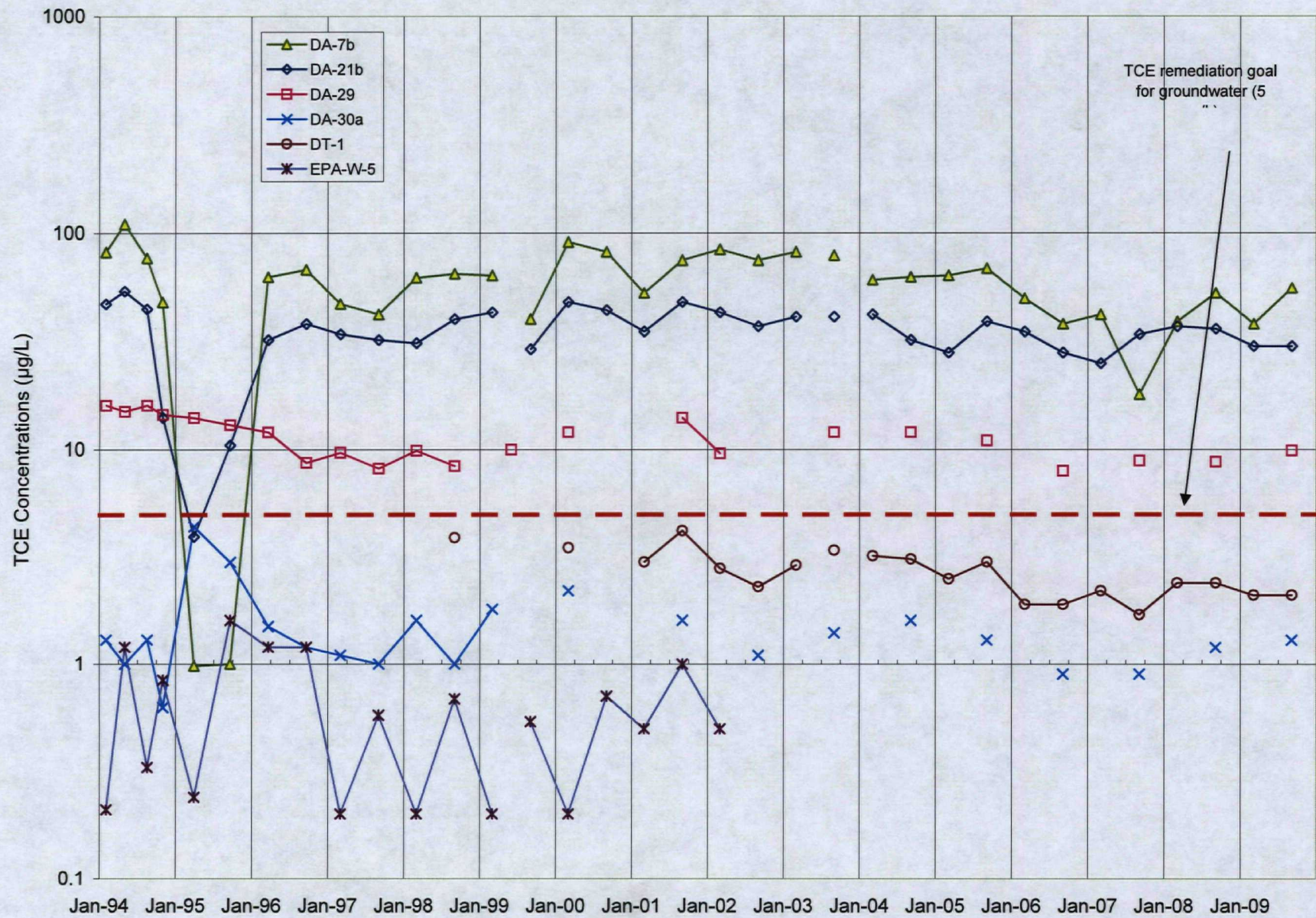


Figure 9
cis-1,2-DCE Concentrations Over Time in Resource Protection Wells Along Plume Centerline

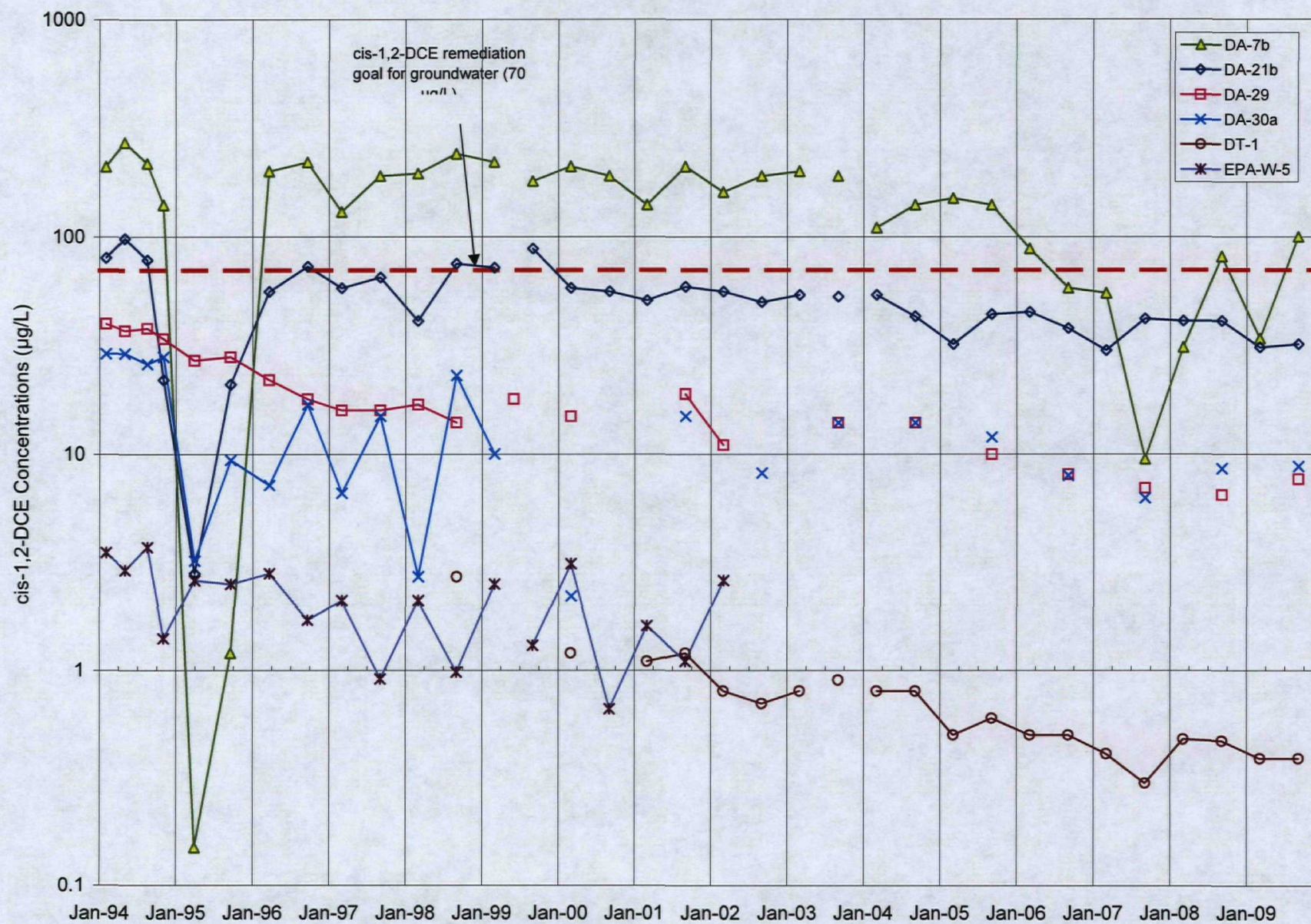


Figure 10
Concentration of TCE in Extraction Wells Over Time
McChord AFB Area D

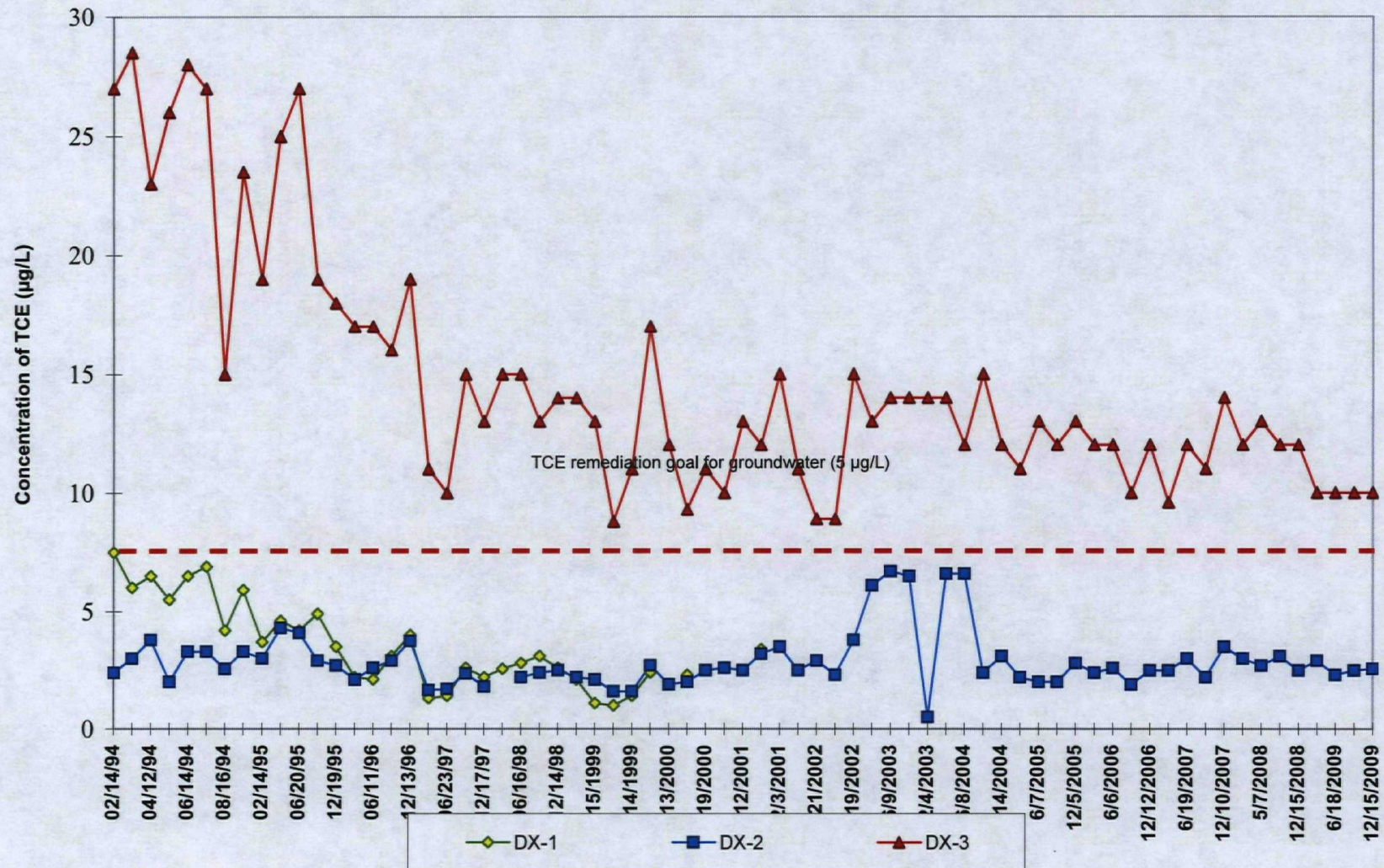
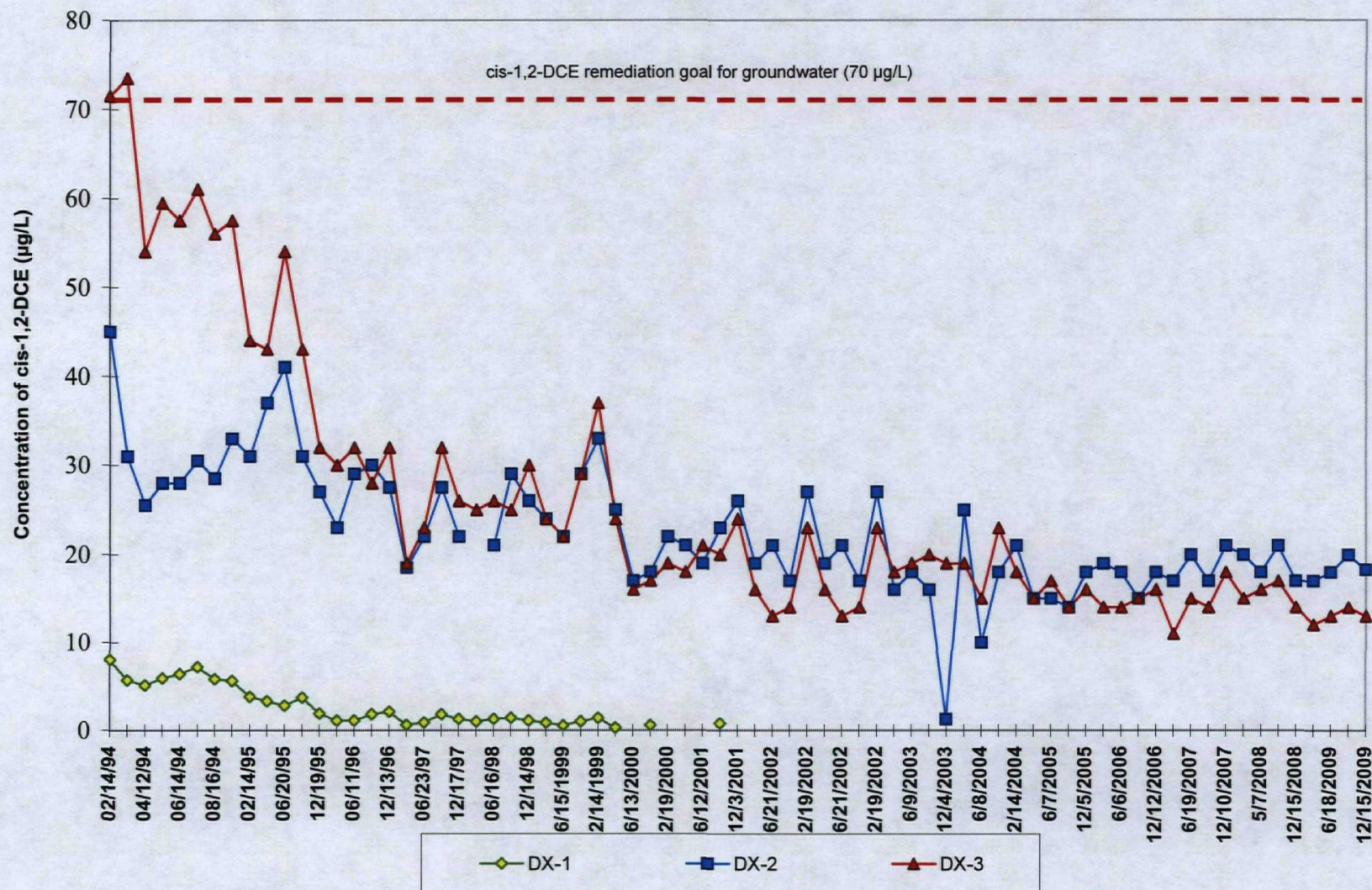


Figure 11
Concentration of cis-1,2-DCE in Extraction Wells Over Time
McChord AFB Area D



Attachment 2

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